Cambridge International AS & A Level

Cambridge International Examinations
Cambridge International Advanced Subsidiary and Advanced Level

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

5016947851

PHYSICS **9702/52**

Paper 5 Planning, Analysis and Evaluation **February/March 2018**

1 hour 15 minutes

Candidates answer on the Question Paper.

No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.

Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

This document consists of **8** printed pages.

DC (CE/CGW) 143991/2

CAMBRIDGE
International Examinations

[Turn over

1 A student is investigating how the extension e of an elastic cord depends on the diameter d of the cord when a force is applied.

The student has a number of elastic cords of the same material with different diameters. The elastic cords have circular cross-sections. Each cord has an unstretched length of approximately 50 cm.

It is suggested that the extension e and the cross-sectional area A of the cord are related by the expression

$$E = \frac{FL}{Ae}$$

where E is the Young modulus of the material of the cord, F is the force applied and L is the unstretched length of the cord.

Design a laboratory experiment to test the relationship between e and d.
Explain how your results could be used to determine a value for E.

You should draw a diagram, on page 3, showing the arrangement of your equipment. In your account you should pay particular attention to

- the procedure to be followed,
- the measurements to be taken,
- the control of variables,
- the analysis of the data,
- any safety precautions to be taken.

Diagram

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[Total: 15]

2 A student is investigating monochromatic light passing through a double slit. Bright and dark fringes are produced on a screen as shown in Fig. 2.1.

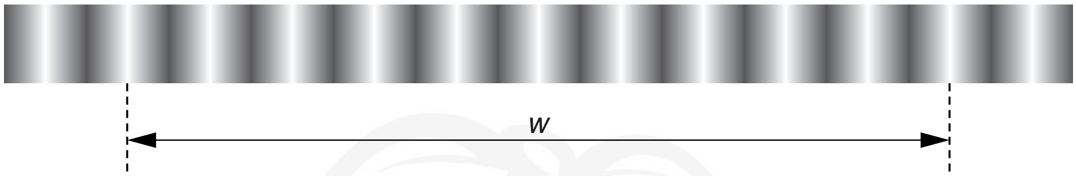


Fig. 2.1

The distance w between 10 bright fringes is measured. The fringe spacing P between neighbouring bright fringes is then determined.

The experiment is repeated for light of different wavelengths λ.

It is suggested that the fringe spacing P and the wavelength λ are related by the equation

$$\frac{P}{D} = \frac{\lambda}{s}$$

where D is the distance from the double slit to the screen and s is the slit separation.

(a) A graph is plotted of P on the y-axis against λ on the x-axis.

Determine an expression for the gradient.

gradient = ...[1]

(b) Values of λ and w are given in Fig. 2.2.

λ / 10^{-7} m	w / mm	P / mm
4.3	39.5 ± 0.5	
4.8	43.5 ± 0.5	
5.3	48.0 ± 0.5	
5.8	52.0 ± 0.5	
6.2	55.5 ± 0.5	
6.6	59.0 ± 0.5	

Fig. 2.2

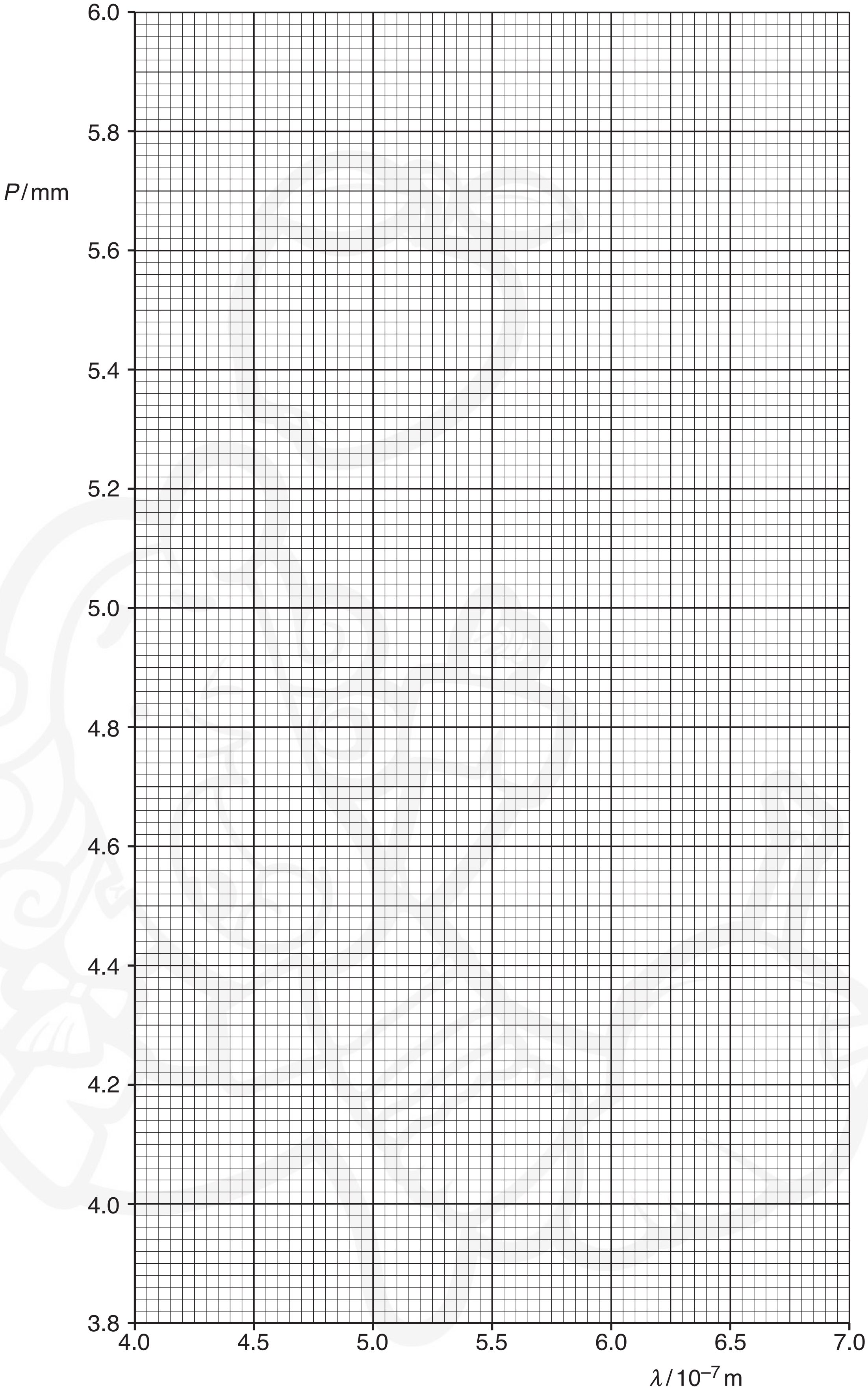
Calculate and record values of P / mm in Fig. 2.2.
Include the absolute uncertainties in P. [2]

(c) **(i)** Plot a graph of P / mm against λ / 10^{-7} m.
Include the error bars for P. [2]

(ii) Draw the straight line of best fit and a worst acceptable straight line on your graph. Both lines should be clearly labelled. [2]

(iii) Determine the gradient of the line of best fit. Include the absolute uncertainty in your answer.

gradient = ...[2]


6.0
5.8
P / mm
5.6
5.4
5.2
5.0
4.8
4.6
4.4
4.2
4.0
3.8
4.0
4.5
5.0
5.5
6.0
6.5
7.0
λ / 10⁻⁷ m

(d) **(i)** Using your answers to **(a)** and **(c)(iii)**, determine the value of *s*. Include an appropriate unit.

Data: $D = 2.20 \pm 0.02\,\text{m}$.

s = ...[3]

(ii) Determine the percentage uncertainty in *s*.

percentage uncertainty in s = ... % [1]

(e) The experiment is repeated using the same double slit but an unknown wavelength λ of light. The distance between 10 fringes w is measured to be $35.0 \pm 0.5\,\text{mm}$.

Determine λ. Include the absolute uncertainty in your answer.

λ = ...[2]

[Total: 15]